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DIFFERENCES BETWEEN CROSSTRAINEES AND NON-CROSSTRAINEES ON GRADE LEVEL, JOB SATISFACTION, AND ASSIGNMENT CHARACTERISTICS

By

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AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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This final report was submitted by Occupation and Manpower Research Division, under project 7734, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235. Mr. William L. Titsworth was the Principal Investigator for the Laboratory.

This report has been reviewed by the Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study is an effort to identify the effects of crosstraining which might have implications for improving the management of Air Force personnel. Data on 7,986 crosstrainees and 15,083 non-crosstrainees working in 35 different Air Force specialties were analyzed to detect differences between these groups with regard to seven criteria. Subjects were enlisted personnel with from 4 to 20 years of service who responded to Air Force job surveys during the period 1967 through 1974. Multiple regression analyses were used which controlled for possible curvilinear relationships between the criteria and length-of-service. In 198 (81%) of 245 criterion-by-specialty analyses, the regression curves appropriate for crosstrainees and non-crosstrainees were not significantly different at the .01 level. In 31 analyses where the groups differed significantly with regard to either grade, number of tasks performed, job

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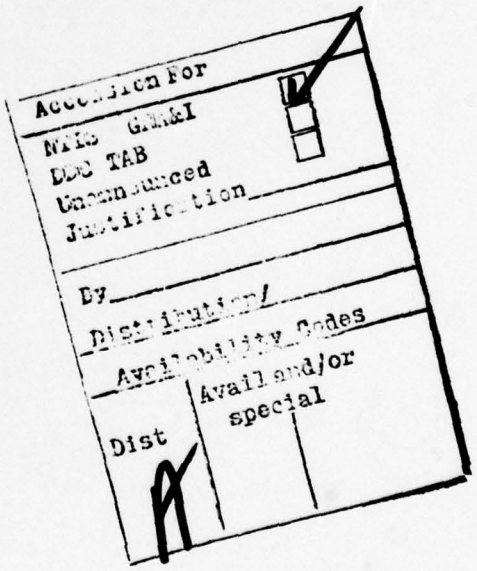
difficulty, or number of subordinates, the non-crosstrainee group predominately had higher expected values. With regard to the 16 significant differences on job satisfaction criteria (reenlistment intent, job interest, and felt utilization of talents and training), no consistent pattern favoring either crosstrainees or non-crosstrainees was observed. Implications of the results are discussed.

PREFACE

This research was conducted under project 7734, Occupation and Career Management; task 773403, Improvement of Skill Management; work unit 77340308, Analysis of Occupational Data for Potential Use in Transferability of Skills Studies. This report completes the initial phase of research efforts on transferability of Air Force skills.

Recognition must be given to Dr. Raymond E. Christal and Dr. Joe T. Hazel for their instrumental roles in directing research conducted under task 773403. The author is indebted to Dr. R. Bruce Gould for prior efforts in consolidating and standardizing the occupational survey data used, and to many people in the Computational Sciences Division/AFHRL–particularly Messrs. Charles A. Greenway and Charles R. Rogers and members of their section–for long and conscientious efforts in producing the data analysis. Special thanks to Ms. Jacobina Skinner for her efforts toward producing this report and to Dr. William E. Alley for substantial contributions to the scheme for determining the appropriate model and for valuable advise on many technical questions.



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DIFFERENCES BETWEEN CROSSTRAINEES AND NON-CROSSTRAINEES ON GRADE LEVEL, JOB SATISFACTION, AND ASSIGNMENT CHARACTERISTICS

I. INTRODUCTION

The policies and procedures for transfering enlisted personnel from one work specialty to another are set forth in Air Force Regulation (AFR) 39-4. Such factors as advances in technology, irregularities in attrition and enlistment rates, and changes in management philosophy on how best to accomplish the Air Force mission operate separately and together to produce overages in some specialties and shortages in others.

The proper use of the crosstraining system should alleviate the average and shortage problems. Also, the system should provide for more efficient utilization of airmen who were, or have become, either overqualified or underqualified for their original specialty. This system might also be used as a tool for increasing job satisfaction and career progress opportunities, thereby enhancing reenlistment rates. Crosstraining could be used as a means of developing a reserve of potentially critical skills or for enhancing the versatility and general capabilities of its airman corps. On the other hand, there are potential costs associated with crosstraining which should be recognized.

It is estimated that about 15,000 airmen crosstrain annually. Of 217,058 airmen who responded to occupational surveys over a 10-year period, 17 percent indicated they had been crosstrained. For each of these crosstraining actions, there were the obvious time and dollar costs of on-the-job training and/or technical school for the crosstrainee. Less obvious costs of such actions are possible detrimental effects on individuals who crosstrain, or even on personnel who do not crosstrain. If the crosstraining system works to the disadvantage of personnel in either of these categories, the results could be poor job attitudes, reduced reenlistment rates, and adverse effects upon work efforts. These developments would be detrimental to the Air Force as well as to the individuals involved. It is important therefore, considering the amount of crosstraining done and the potential costs involved, that the crosstraining system function as fairly and as efficiently as possible.

This research represents an initial effort to determine if an appreciable difference exists between crosstrainees and non-crosstrainees with regard to selected factors which could adversely affect reenlistment rates or worker performance and, hence, force effectiveness. The goals are to identify areas where efforts to improve the crosstraining system are appropriate and to indicate directions for future research.

II. METHOD

The subjects of this study were Air Force enlisted personnel with at least 4 and at most 20 years of service who responded to occupational surveys conducted in their specialty according to AFR 35-2. Personnel with less than 4 years of service were not included because of indications that substantially different relationships between criteria selected for study and length of service generally exist for that group (Gould, 1976) and because the number of crosstrainees in that category might not have been large enough to provide a reliable picture of the relationship of criterion to length of service. Airmen with more than 20 years of service were excluded in an effort to make the analysis more sensitive to important differences. This effect was realized to the extent that personnel with more than 20 years of service are homogeneous with regard to the criteria.

Table 1 is a listing of the specialties involved in this study, along with the date of the survey used for each, the number of useable responses to the survey, and the percentage of respondents who indicated they had crosstrained into the specialty. The surveys selected were the most recent available for the specialty and were the 35 with the largest number of useable responses. A large number of responses was desired to maximize confidence in the stability of obtained results. The number of specialties involved was as large as practical considerations would allow.

The information reported by survey respondents included: (a) lengths of time in service and in specialty, (b) enlisted grade, (c) number of direct subordinates to their position, (d) attitudes on reenlistment intent, job interest and utilization of talents and training, (e) estimates of the relative amount of time spent on each task performed in the specialty, and (f) an indication of whether or not they had crosstrained from another specialty. This information was quantified into a number of variables which were used in the multiple regression analyses.

Criteria

The first of the seven variables which were investigated for systematic differences between crosstrainees and non-crosstrainees was *grade level*. It was set equal to integers 1 through 9 corresponding exactly to the enlisted grade of the respondent. (E-1 for Airman Basic through E-9 for Chief Master Sergeant.)

The *reenlistment intent* criterion was based on subjects response to a statement like "I plan to reenlist." The possible responses were a definite "No," "Probably no," "Probably yes," "Yes," and "I plan to retire."

A relative 7-point scale was used for the *job interest* criterion with a 1 indicating "I find my job extremely dull" and a 7 indicating "I find my job extremely interesting."

The *felt utilization* criterion was based on responses to "My job utilizes my talents and training." "Not at all" was coded 1 and "Perfectly" was coded 7. Values of 2 through 6 indicate attitudes relative to these two extremes.

The *number of tasks performed* criterion was based on the relative-time-spent rating given each task in a specialty's inventory. This value indicates the total number of tasks involved in the respondent's job (as indicated by a non-zero rating). The possible range of this variable is from 1 to some value less than 700 (depending on the number of tasks in the inventory for the particular specialty).

As a measure of *job difficulty*, the ATDPUT (average task difficulty per unit time) variable was computed (Mead & Christal, 1970). The ratio of the relative-time-spent rating given each task to the total of such ratings given all tasks in the inventory was multiplied by the mean of relative difficulty ratings given that task by supervisors from that specialty. The sum of these products for all tasks performed is the ATDPUT value. It can be interpreted as the probable relative difficulty rating of the task being performed at any particular time. The range of this criterion is between 0 and 8 with higher values indicating greater difficulty. Since the task difficulty ratings on which ATDPUT is based are relative only to other tasks in the same specialty, cross-specialty comparisons of these values are not meaningful.

The final criterion is the *number of subordinates*. If respondents indicated they had 9 or more personnel reporting directly to them for supervision, their value on this variable was set to 9. Otherwise the value assigned was from 0 to 8, corresponding exactly to the reported number of subordinates.

Predictor Variables

The "X" or crosstrained group identifying variable was set equal to 1 if the subject checked the block indicating he or she was assigned to the specialty by retraining from another specialty.

Table 1. **Number of Crosstrained and Non-Crosstrained Personnel in Surveys of 35 Air Force Specialties**

DATE OF SURVEY	SPECIALTY CODE*	SPECIALTY DESCRIPTION*	PERCENT CROSS-TRAINED	NUMBER OF CROSS-TRAINEES	NUMBER OF NON-CROSS-TRAINEES	TOTAL
6/73	204X0	INTELLIGENCE OPERATIONS	32.67	132	272	404
9/70	272X0/A/B/C	AIR TRAFFIC CONTROL	30.25	226	521	747
11/68	303X3/90	AUTO TRACKING RADAR	41.76	195	272	467
3/71	304A1/95	FLIGHT FACILITIES EQUIPMENT	30.23	143	330	473
3/72	305A4/A8C0	ELECTRONIC COMPUTER SYSTEMS MAINTENANCE	49.00	563	586	1149
10/72	307X0	TELECOMMUNICATIONS SYSTEMS	40.91	234	338	572
1/70	317X0	INSTRUMENTATION MECHANIC/TECHNICIAN	56.45	175	135	310
6/72	322X1/A8CNPQS	WEAPONS CONTROL SYSTEMS	42.10	549	755	1304
3/70	324X0	PRECISION MEASURING EQUIPMENT	83.69	826	161	987
8/71	325X0/91	AUTO FLIGHT CONTROL SYSTEMS MAINTENANCE	24.69	197	601	798
7/72	328X0/99/A	AVIONICS COMMUNICATIONS	13.51	131	839	970
7/73	326X3/99	ELECTRONIC WARFARE SYSTEMS REPAIR	21.43	168	616	784
5/73	342X0	FLIGHT SIMULATOR	33.80	169	331	500
2/73	391X0/A/B	MAINTENANCE ANALYSIS SPECIALIST/TECHNICIAN	46.53	181	208	389
10/70	421X3	AEROSPACE GROUND EQUIPMENT REPAIR	20.52	181	701	882
1/69	422X1/92	AIRCRAFT ENVIRONMENTAL SYSTEMS APR	34.87	144	269	413
2/68	424X0	AIRCRAFT FUEL SYSTEMS	58.96	283	197	480
2/69	431X1E	AIRCRAFT MAINTENANCE, 2+ JET ENGINES	13.64	115	728	843
12/72	431X0/ECD/91	HELICOPTER MAINTENANCE	30.82	172	386	558
3/72	432X0/91	JET ENGINE MECHANIC	15.09	238	1339	1577
3/71	461X0/X0A/90	MUNITIONS MAINTENANCE	47.33	266	296	562
3/71	464X0	MUNITIONS DISPOSAL	67.20	252	123	375
6/67	543X0	ELECTRIC POWER PRODUCTION	34.27	196	376	572
8/70	545X0/790	REFRIG., AIRCOND., & HEATING SYSTEMS	33.29	122	245	367
7/74	605X0/X0A	AIR PASSENGER	29.14	354	861	1215
1/69	611X0/290	AIRMAN SUPPLY SERVICES	34.57	196	371	567
2/70	651X0	PROCUREMENT	68.66	276	126	402
3/74	691X0	MANAGEMENT ANALYSIS	74.09	143	50	193
1/74	705X0	LEGAL SERVICES	78.80	223	60	283
6/71	732X0/A/93	AIRMAN PERSONNEL	22.09	205	723	928
8/74	732X1/99	PERSONAL AFFAIRS	70.59	180	75	255
12/73	741X0/71	SPECIAL SERVICES	40.30	214	317	531
12/73	81[illegible]	SECURITY POLICE	5.77	88	1436	1524
3/74	90[illegible]	RADIOLOGY	39.39	130	200	330
12/72	9[illegible]X0/71	MEDICAL LAB	33.24	119	239	358
		PERCENTAGE AND TOTALS FOR ALL 35 SPECIALTIES	34.62	7986	15083	23069

* SPECIALTY CODE AND DESCRIPTION CURRENT AS OF DATE OF SURVEY.

Otherwise "X" was set equal to zero. The counterpart of the "X" variable for identification of the non-crosstrained group is "N." It has a value of 1 if the subject did not indicate crosstraining and a value of zero otherwise. "N" was computed by subtracting "X" from "U," the vector containing only unit values. "M" is the months of service variable. It took the value which the subject reported to be his or her "total months active federal military service." Other variables which were used as predictors in regression models are interactions or vector products of the "M" and "X" or "N" variables. For instance the "XM" variable is equal to months in service if the respondent crosstrained, or is equal to zero if the subject did not crosstrain. It was generated by multiplying variable "X" by variable "M." The variable "MM" was generated by multiplying the "M" variable by itself. It represents the square of the number of months the subject has spent in the service. Inclusion of this squared variable, or its interaction with "X" or "N" in a regression model provides for a curved regression line.

Multiple Regression Analyses

A total of 245 regression analyses, one for each of the seven criteria in each of the 35 specialties, were performed. These analyses were designed to detect differences between crosstraining status (treatment) groups on the criterion measure while identifying and controlling for any linear or curvilinear relationships between the criterion and the length-of-service (concomitant) variable. This design is a generalization and embellishment of the analysis scheme described in Section 5.2 of Bottenberg and Ward (1963). Essentially the technique is to calculate the equation for the regression lines which best fit the data on the criterion to length-of-service relationship for each crosstraining status group, to determine whether there is a significant difference between these two lines and to find out if they are unsloped, sloped, or curved.

The first step in each analysis was to compute the 14 different regression models specified in Table 2. An iterative technique was used to estimate the least-squares regression weights for

Table 2. **Regression Models**

Model No.	Predictor Variables (Independent Set)	Graphic Representation		Relationship of Graphs for Two Groups
		For Crosstrainees	For Non-Crosstrainees	
1	X, XM, XMM, N, NM, NMM	curve	curve	independent[a]
2	X, XM, XMM, N, NM	curve	sloped line	independent[a]
3	X, XM, XMM, N	curve	unsloped line	independent[a]
4	X, XM, N, NM, NMM	sloped line	curve	independent[a]
5	X, N, NM, NMM	unsloped line	curve	independent[a]
6	X, XM, N, NM	sloped line	sloped line	independent[b]
7	X, XM, N	sloped line	unsloped line	independent[b]
8	X, N, NM	unsloped line	sloped line	independent[b]
9	X, N, M, MM	curve	curve	parallel
10	X, N, M	sloped line	sloped line	parallel
11	X, N	unsloped line	unsloped line	parallel
12	M, MM, U	curve	curve	coinciding
13	M, U	sloped line	sloped line	coinciding
14[c]	U	unsloped line	unsloped line	coinciding

[a]The regression curves (or the line and the curve) may intersect twice, once, or not at all in the range of interest.

[b]The regression lines may intersect once or not at all in the 48–240 months-service range of interest.

[c]The least squares regression weight (and hence the expected criterion value) for the unit-vector model is the mean of the criterion. Its predictive efficiency is assumed zero.

each predictor variable in each model and to calculate the efficiency (squared multiple correlation coefficient) with which the variables and weights can be used to predict the involved criterion. Each of these models makes different provisions for describing the interrelationships among the criterion, crosstraining status, and length of service. For example, model 12 graphically describes the relationship between the criterion and length of service for both crosstrainees and non-crosstrainees in terms of a single regression curve. Model 2 on the other hand describes this relationship in terms of a curve for crosstrainees and a straight, unsloped line for non-crosstrainees. The provisions of model 10 are two parallel sloped lines, one for each crosstraining status group.

The next step in each analysis was to compute the 13 F-ratios specified in Table 3. This table indicates the full and restricted models which were tested for significant difference in predictive efficiency in each test, along with the degrees of freedom involved. Several of these ratios and a significance level of .01 were used to determine which of the 14 models most appropriately described the interrelationships of the variables. One part of the problem was to determine if the data on the relationship between the criterion and length of service for each crosstraining status group were fit signficantly better by a curved line than by a sloped line and, if not, to find out if the data were fit significantly better by a sloped line than by an unsloped line. If data on both crosstrained and non-crosstrained groups were appropriately fit by the same type of regression line (either curved, sloped or unsloped), another part of the problem was to determine whether independent lines fit significantly better than parallel lines and, if not, whether parallel lines fit significantly better than a single line. The exact conditions used to determine the appropriate model are indicated in Table 4. Appendix A is a detailed discussion of the logic, sequence, and underlying hypotheses of this analysis scheme.

After the appropriate model was determined, the regression weights for that model were analyzed to obtain a more precise picture of the important interrelationships. For each sloped line in the model the sign of the slope was noted. A positive slope indicates that expected criterion values increase as the length of service increases. Conversely, a negative slope means expected values will decrease with length of service.

Table 3. **F-Tests**

Designation	Full Model	Restricted Model	$(df)_1$	$(df)_2$
A	1	6	2	n-6
B	6	10	1	n-4
C	10	13	1	n-3
D	13	14	1	n-2
E1	6	7	1	n-4
E2	6	8	1	n-4
F	10	11	1	n-3
G	1	9	2	n-6
H	9	12	1	n-4
I1	1	2	1	n-6
I2	1	4	1	n-6
J1	2	3	1	n-5
J2	4	5	1	n-5

Table 4. **Conditions Determining Appropriate Model**

Model No.	F-Tests Significant (S) or Non-Significant (N)													Relative Predictive Efficiency of Models 2 and 4 or Models 7 and 8[a]
	A	B	C	D	E1	E2	F	G	H	I1	I2	J1	J2	
1	S							S		S				RSQ2>RSQ4
1	S							S			S			RSQ2<RSQ4
2	S							S		N		S		RSQ2>RSQ4
3	S							S		N		N		RSQ2>RSQ4
4	S							S			N		S	RSQ2<RSQ4
5	S							S			N		N	RSQ2<RSQ4
6	N	S			S									RSQ7>RSQ8
6	N	S				S								RSQ7<RSQ8
7	N	S			N									RSQ7>RSQ8
8	N	S				N								RSQ7<RSQ8
9	S							N	S					
10	N	N	S				S							
11	N	N	S				N							
12	S							N	N					
13	N	N	N	N										
14	N	N	N	N										

[a]Since models 2 and 4 are of the same complexity (have the same number of independent predictors) the one with the lower predictive efficiency and its restriction (*either* model 3 or model 5) were automatically eliminated from the process of determining the appropriate model. Likewise with regard to models 7 and 8.

For each curved regression line intrinsic to the model, the sign of the slope on each side of the point-of-inflection and the relationship of the point-of-inflection to the range-of-interest bounds were determined. This information was used to indicate whether expected criterion values increased and/or decreased and whether the rate of change was increasing or decreasing with length of service.

In situations where separate .curves or lines were appropriate for crosstrainees and non-crosstrainees, the group having the superior curve (and thus the higher expected criterion values) was identified. If the identity of the group with the superior curve changed (i.e., the curves intersected) inside the range of interest, the point or points of change were calculated, and the proportions of the total range of interest for which each group had the higher expected values were calculated. Also, the largest difference between expected criterion values for the two groups—and its point(s) of occurrence—were determined. Because the number of cases involved in these regression analyses was often relatively large, this information was needed to ascertain whether any significant differences found between crosstrainees and non-crosstrainees were also large enough (in terms of the scale of the criterion) to be of practical importance.

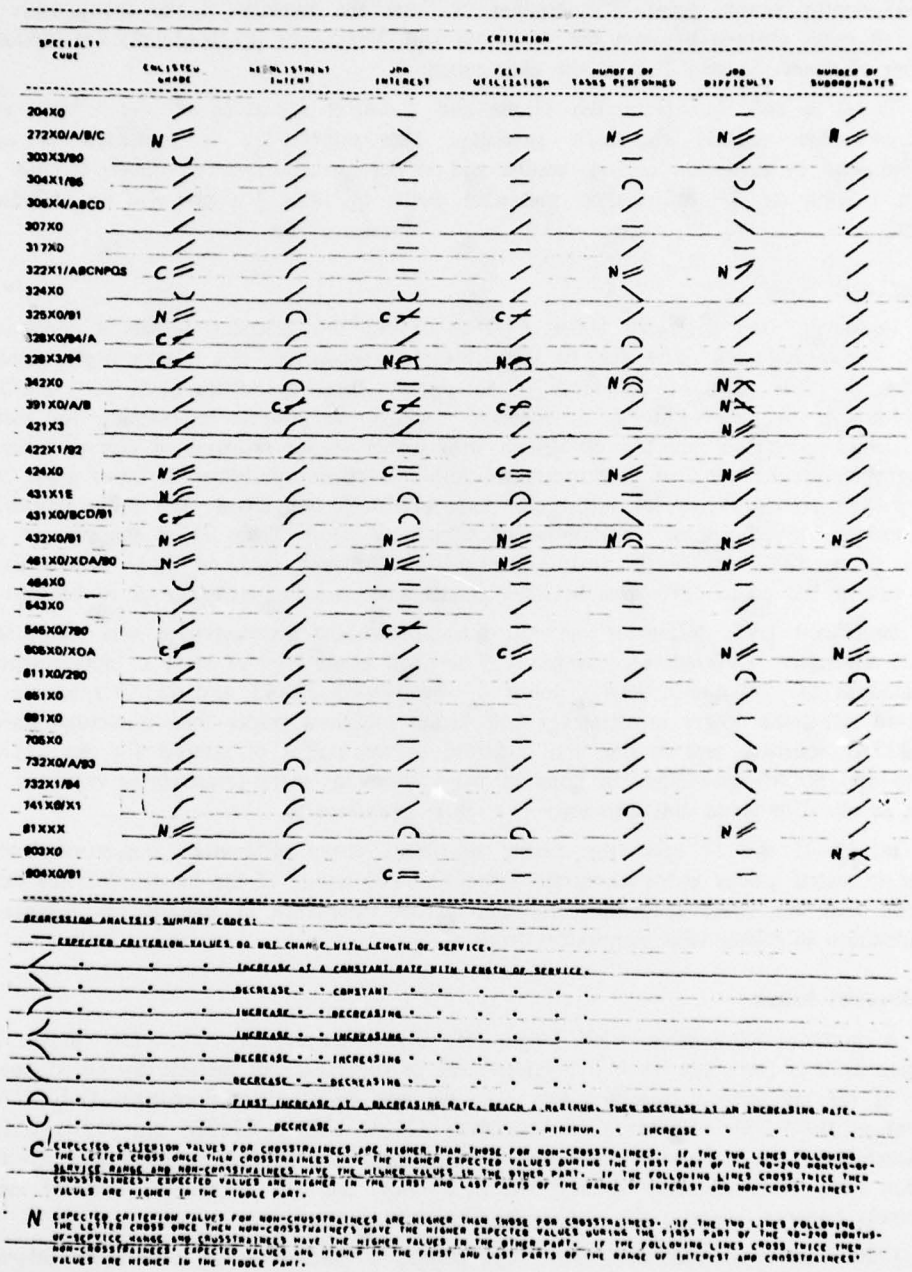
In addition to the seven regression analyses, the means and standard deviations of all regression analysis variables were computed for each specialty. This information is useful in interpreting the regression analyses results.

III. RESULTS AND DISCUSSION

Table 5 is a summary of the results of the 245 regression analyses performed. Each regression analysis summary code in this table indicates the interrelationships among (a) crosstraining status, (b) a particular criterion, and (c) length of service in a particular specialty.

The line or lines in these codes are graphic descriptions of the general relationship between the criterion and length of service. An unsloped line (–) indicates no significant relationship, while a positively sloped line or curve (/, ⌒ or ⌣) indicates a positive relationship, and a negatively

Table 5. **Summary of Regression Analyses Results for 7 Criteria in 35 Air Force Specialties**



sloped line or curve (\, ⟍ or ⟍) means the relationship is negative. If this relationship changes from positive to negative, or from negative to positive within the range of interest, those occurrences are indicated by "bottom-open" curves (∩, ⌒ or ⌒) or "top-open" curves (∪, ⌣ or ⌣) respectively.

If the code for an analysis consists of two lines, a significant difference exists between crosstrainees and non-crosstrainees. The letter preceding the two lines identifies the initially

superior line or curve as being for crosstrainees (C) or for non-crosstrainees (N). The indicated group, identified by (C) or (N) on the superior curve, has the higher expected criterion values at the 48-months service point. The number of times the identity of the group with the higher expected value changes between the 48-month and 240-month points-of-service is indicated by the number of times the two lines in the code cross.

Tables 6 and 7 contain the means and standard deviations of the criteria and of the length-of-service variable for each specialty. This information is presented to aid in the interpretation of regression analysis results and in the formation of hypotheses suitable for further research. Some of the information presented earlier in Table 1 might also be of value in these efforts.

Grade Level

Review of the summary codes in Table 5 for this criterion reveals a consistent positive relationship with length of service. In each of the 35 specialties, this relationship is significant, and only in the first parts of the range of interest in three specialties (14% for 303X3, 15% for 324X0 and 19% for 464X0) is it indicated negative. A possible explanation for these negative relationships is that a number of airmen with higher grades crosstrained out of these specialties during their second term of enlistment. An influx to these specialties of lower grade crosstrainees during their second enlistment might also have produced this effect. The influx possibility is not inconsistent with the mean of months-not-in-specialty (from Table 7) or the percent crosstrained values (from Table 1) for the involved specialties. However, such an influx would also probably have caused the grade differences between crosstrainees and non-crosstrainees to become significant.

Significant grade difference between the crosstraining status groups was indicated in 12 of the 35 specialties. Differences of as much as one-half grade level in favor of non-crosstrainees were indicated at the 240-month service points of the 328X0, 328X3, and 431X0 specialties. The only observed situations where crosstrainees had higher expected grades than non-crosstrainees were in the 322X1 specialty and in the first one-third of the ranges of interest for the 328X0, 328X3, 431X0 and 605X0 specialties. In none of these situations were crosstrainees expected to have as much as one-fifth grade unit advantage over their counterparts.

In 11 of the 12 specialties having significant group differences, non-crosstrainees had the higher expected grades at the far extreme (the 240-month point) of the length-of-service variable. This suggests that for these specialties the amount of experience in specialty is a more important consideration in higher level promotion decisions.

Reenlistment Intent

A positive relationship with length of service is just as consistently indicated for this criterion as it is for grade level. In 99.5 percent of the ranges of interest for all 35 specialties the slope of the appropriate regression line or curve was significant and positive. Only in the last 10 percent of the ranges of interest for specialties 325X0, 342X0, 732X0, and 732X1 was a negative relationship indicated. Considerations which might help explain this preponderance are (a) subjects of this study have probably already reenlisted once, and (b) as length of service increases, the retirement benefits incentive for reenlistment becomes stronger.

Unlike the grade criterion, there was almost no indication of differences between groups. Crosstrainees in the 391X0 specialty were indicated to have a reenlistment intent value .52 scale unit (one-half standard deviation for the whole variable) higher than non-crosstrainees at the 48-month service point, and .31 scale unit lower than their counterparts at the 240-month service point. The point of service at which the expectation of higher values stops for crosstrainees and non-crosstrainees is 169 months or 63 percent through the range of interest.

Table 6. **Means and Standard Deviations for Criteria**

SPECIALTY CODE	ENLISTED GRADE		REENLISTMENT INTENT		JOB INTEREST		FELT UTILIZATION		NUMBER OF TASKS PERFORMED		JOB DIFFICULTY		NUMBER OF SUBORDINATES	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
209X0	5.66	.85	4.61	1.05	4.57	1.70	3.25	1.47	92.10	32.09	4.43	.37	1.19	1.97
272X0/A/B/C	5.85	.94	4.69	1.27	6.22	1.09	5.30	1.96	151.50	52.93	3.93	.17	2.65	2.62
303X3/90	5.93	1.01	4.55	1.23	4.87	1.48	3.75	1.49	86.30	69.83	4.89	.99	2.10	3.03
309X1/95	5.79	1.11	4.69	1.11	5.13	1.93	4.19	1.59	139.59	92.99	4.91	.29	2.07	2.59
305X4/ABCD	5.97	.84	4.61	1.19	4.98	1.99	3.93	1.98	81.95	53.08	3.35	.07	1.60	2.39
307X0	5.90	.91	4.63	1.29	4.80	1.55	3.76	1.52	66.95	39.73	3.35	.01	2.23	2.82
317X0	5.89	.93	4.85	1.09	5.35	1.30	4.17	1.53	85.78	53.05	4.89	.23	2.99	2.95
322X1/ABCNPQS	5.82	.94	4.69	1.05	5.12	1.39	4.15	1.97	77.75	58.63	3.79	.39	2.50	2.96
329X0	5.71	.87	4.93	1.23	5.39	1.23	4.51	1.35	183.26	126.89	4.73	.29	1.52	2.62
325X0/91	5.98	.95	4.59	1.19	4.96	1.91	4.01	1.98	101.70	53.08	3.89	.15	2.99	3.15
328X0/99/A	5.89	.96	4.62	1.10	5.02	1.33	4.03	1.90	125.68	65.68	3.83	.18	2.69	3.25
328X3/99	5.50	.92	4.38	1.26	4.75	1.97	3.55	1.37	88.46	59.79	3.35	.13	2.68	3.17
349X0	5.35	.80	4.52	1.10	5.22	1.33	4.09	1.38	162.91	76.13	4.60	.33	1.65	2.30
391X0/A/B	5.57	.95	4.72	1.09	5.26	1.38	3.95	1.59	69.18	39.15	5.05	.59	1.31	1.87
421X3	5.49	.92	4.68	1.15	4.99	1.97	4.10	1.53	149.90	91.79	4.85	.32	3.30	3.33
422X1/92	5.51	.86	4.74	1.07	5.65	1.06	4.71	1.39	100.79	45.92	5.02	.21	3.59	3.25
429X0	5.32	.91	4.80	1.05	5.96	1.38	4.78	1.45	135.06	56.50	4.86	.20	4.36	4.39
431X1E	5.59	.81	4.75	1.15	5.39	1.32	4.60	1.97	99.62	56.21	4.81	.38	4.03	3.52
431X0/BCD/91	5.35	.91	4.73	1.09	5.25	1.37	4.38	1.50	171.36	103.98	4.89	.41	2.80	3.29
432X0/91	5.35	.93	4.75	1.07	5.29	1.32	4.47	1.55	76.39	49.10	3.95	.12	3.23	3.19
461X0/X0A/90	5.99	.99	4.69	1.16	4.53	1.66	3.55	1.61	53.35	40.32	4.46	.49	3.33	3.05
469X0	5.69	.83	4.97	.93	5.97	1.36	4.05	1.61	196.09	70.08	5.22	.30	1.16	1.96
593X0	5.05	.92	4.68	1.10	5.71	1.23	4.57	1.60	139.18	92.75	4.15	.23	4.13	4.37
595X0/290	5.15	.69	4.86	1.10	5.58	1.42	4.39	1.60	135.20	75.26	4.60	.29	2.36	3.18
605X0/X0A	5.39	.95	4.73	1.03	5.27	1.90	4.18	1.59	52.30	47.37	4.99	.50	2.87	3.21
611X0/290	5.07	.89	4.95	1.02	5.17	1.63	4.25	1.79	61.26	49.79	4.79	.50	2.62	3.02
651X0	5.87	.92	4.96	1.07	5.69	1.35	4.52	1.56	57.10	32.05	5.09	.32	1.99	2.65
691X0	5.64	.96	4.90	.93	4.95	1.50	3.76	1.97	60.90	33.06	3.39	.10	1.02	1.59
705X0	5.60	.86	4.89	.96	5.67	1.36	4.76	1.56	77.71	46.68	3.69	.95	1.28	1.98
732X0/A/93	5.77	1.03	4.81	.92	5.36	1.39	4.51	1.63	52.98	39.06	5.09	.35	1.53	1.93
732X1/99	5.48	.91	4.68	1.05	5.49	1.32	4.60	1.50	103.37	57.29	3.61	.93	1.10	1.90
791X0/A1	5.29	1.02	4.79	.93	5.53	1.99	4.39	1.81	113.61	73.58	5.20	.96	3.00	3.09
81XXX	5.25	.84	4.75	1.10	5.07	1.63	4.16	1.68	64.77	46.83	4.92	.92	3.66	3.69
903X0	5.15	.97	4.67	1.33	5.90	1.30	4.29	1.98	135.38	63.12	3.91	.21	2.92	3.05
904X0/91	5.31	.83	4.92	1.15	5.56	1.32	4.36	1.53	96.29	63.15	3.33	.06	2.19	2.86

Table 7. **Means and Standard Deviations of Months of Service for Crosstrainees and Non-Crosstrainees in 35 Specialties**

SPECIALTY CODE	CROSSTRAINEES						NON-CROSSTRAINEES		NON-CROSSTRAINEES	
	MONTHS IN SPECIALTY		MONTHS NOT IN SPECIALTY		TOTAL MONTHS SERVICE		TOTAL MONTHS SERVICE		TOTAL MONTHS SERVICE	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
409XQ	63.38	46.12	85.17	106.89	148.55	52.50	199.32	63.63	199.32	63.63
272XL/A/B/C	67.17	38.67	92.60	117.27	159.77	52.94	197.20	59.69	197.20	59.69
403X3/9Q	69.10	49.66	86.65	111.33	152.74	55.18	195.76	54.01	195.76	54.01
309XI/95	74.60	53.92	98.84	120.37	173.44	51.49	151.72	57.89	151.72	57.89
305X9/A&CD	80.02	44.01	93.41	126.02	173.43	53.55	125.39	57.68	125.39	57.68
307XQ	103.26	45.46	95.46	137.21	198.72	34.36	121.28	66.93	121.28	66.93
317XQ	74.36	39.43	99.96	125.93	174.32	50.32	134.57	64.99	134.57	64.99
322XI/A&CNPQS	65.43	57.91	97.90	113.70	163.34	58.90	150.37	65.99	150.37	65.99
329XQ	81.24	36.67	101.77	130.36	183.11	42.22	175.99	39.82	175.99	39.82
345XQ/91	104.67	49.16	79.21	127.88	183.88	47.11	130.95	61.13	130.95	61.13
326XQ/94/A	78.69	41.46	79.36	115.23	158.05	50.92	195.92	60.02	195.92	60.02
348X3/94	84.28	54.62	81.23	116.73	165.51	54.00	133.73	63.18	133.73	63.18
342XQ	95.10	69.38	87.30	119.58	172.90	55.54	116.72	58.63	116.72	58.63
391XQ/A/B	89.14	56.02	91.34	116.61	160.98	65.84	133.12	67.72	133.12	67.72
921XJ	111.92	50.09	66.97	123.58	180.94	48.34	191.93	62.01	191.93	62.01
922XI/92	77.96	40.80	97.63	124.44	175.44	44.12	125.59	55.07	125.59	55.07
947XQ	63.52	49.25	98.38	112.98	161.90	51.88	126.58	56.19	126.58	56.19
931XIE	93.52	70.09	52.42	92.05	145.94	59.84	136.90	56.71	136.90	56.71
931XQ/9LQ/91	84.31	70.09	80.33	107.50	144.65	53.20	137.53	60.66	137.53	60.66
932XQ/91	90.90	73.61	87.90	118.11	180.50	55.49	133.19	63.66	133.19	63.66
961XQ/XQA/9Q	85.96	27.01	126.39	104.26	162.38	50.02	139.07	65.30	139.07	65.30
964XQ	89.84	50.54	82.47	120.59	167.31	55.74	183.70	99.50	183.70	99.50
943XQ	85.84	38.40	98.73	129.88	184.57	37.33	116.06	52.83	116.06	52.83
945XQ/79Q	82.56	53.00	99.11	124.16	181.67	43.13	133.67	56.93	133.67	56.93
605XQ/XQA	69.36	44.69	94.76	119.16	164.12	55.35	126.06	62.33	126.06	62.33
611XQ/29Q	95.90	47.24	76.82	120.27	172.72	44.94	152.30	57.96	152.30	57.96
951XQ	96.62	48.64	77.29	123.75	175.30	50.29	153.60	63.96	153.60	63.96
971XQ	80.64	51.04	76.80	114.11	157.64	54.70	137.12	62.98	137.12	62.98
705XQ	78.17	49.82	76.95	110.60	155.05	56.73	195.58	63.93	195.58	63.93
73XXQ/XA/93	101.22	70.07	56.56	103.93	157.82	64.93	199.09	61.89	199.09	61.89
73XX1/99	61.70	33.27	75.58	102.83	136.78	49.29	159.03	56.60	159.03	56.60
741XQ/X1	70.03	44.04	67.91	107.03	147.93	46.81	139.87	61.25	139.87	61.25
61XXA	110.80	66.70	27.90	76.97	138.69	69.99	138.67	69.19	138.67	69.19
903XQ	92.41	59.99	69.82	87.20	137.92	62.65	129.19	67.85	129.19	67.85
904XQ/91	86.99	60.01	68.51	93.80	135.95	57.65	125.79	61.99	125.79	61.99

Job Interest

On the job interest criterion, there is a slight indication that group differences exist with regard to the type of relationship with length of service. For crosstrainees the relationship between job interest and length of service was non-significant 57 percent of the time, positive 34 percent, and negative 9 percent. For non-crosstrainees these percentages are 49, 43, and 8, respectively. Non-crosstrainees appear to be more likely to have job interest increase with length of service. On the other hand, there is little direct evidence that the two groups differ consistently on this criterion.

Significant differences between groups were found in only eight specialties. In the overall ranges of interest for these eight specialties, one group had the higher expected values about as often as the other (55 percent for crosstrainees, 45 percent for non-crosstrainees). The largest differences between expected job interest values were about one scale unit or about two-thirds standard deviation of the whole criterion variable for the specialty.

Felt Utilization of Talents and Training

As with job interest, the type of relationship of felt utilization of talents and training with length of service may be related to crosstraining status. Overall, these relationships for crosstrainees are 40 percent non-significant, 57 percent positive, and 3 percent negative. For non-crosstrainees, these relationships are non-significant in 34 percent of the situations, positive in 63 percent, and negative in the remaining 3 percent. Again the indication is that a positive relationship is more likely for non-crosstrainees. One difference between this criterion and job interest is that the length of service relationship is negative less often for felt utilization. Also, for job interest, this relationship is non-significant more than half the time. For felt utilization, this proportion is somewhat less than half.

With regard to differences between groups, the findings for this criterion are very much like those for job interest. Significant differences were indicated in seven of the specialties (compared to eight for job interest), and in these situations, crosstrainees and non-crosstrainees had the higher expected values equally as often. The largest of these differences was 1.25 scale units in favor of crosstrainees at 48 months of service in the 371X0 specialty.

Number of Tasks Performed

For the number-of-tasks-performed criterion the relationship with length of service was non-significant 34 percent of the time, positive 54 percent, and negative 12 percent. These percentages were the same for both crosstrainee and non-crosstrainee groups. A negative criterion to length-of-service relationship might suggest that the ratio of the number of supervisory tasks to the number of technical tasks in the inventory for a particular specialty is relatively low.

Significant differences on expected criterion values for crosstrainees and non-crosstrainees were indicated in only five of the 35 specialties. The largest of these differences was 25 tasks or about .4 of the criterion's standard deviation for that specialty (342X0). The most notable finding for these five differences is that non-crosstrainees are always indicated to perform more tasks.

Job Difficulty

The relationship between job difficulty and length of service is predominately positive (63% for both crosstrainees and non-crosstrainees). However, the incidence of negative relationships is higher than for the other criteria (14% for crosstrainees and 17% for non-crosstrainees). A possible explanation for a negative relationship here is that the specialty is highly technical, and the journeyman level tasks are considered more difficult than those which must be done by supervisors.

Significant differences between crosstrainees and non-crosstrainees were found in 10 of the 35 specialties. The largest difference was .44 ATDPUT scale-point units (1-1/3 standard deviation units) at the 48 months service point in the 324X0 specialty. Of all the situations where group differences on job difficulty were indicated, the non-crosstrainees group had the higher expected value 90 percent of the time.

Number of Subordinates

Findings on the relationship of this criterion to length of service are very similar to those for grade and reenlistment intent. In none of the specialties is a non-significant relationship indicated, and only in 3 percent of the total ranges of interest (for both crosstrainees and non-crosstrainees) are the relationships negative. Thus, the number of subordinates is expected to increase with length of service 97 percent of the time.

Group differences were indicated significant in only four specialties. The largest such difference was indicated for the 240 months-service point in the 903X0 specialty. Crosstrainees in this category are expected to have an average of 1.43 more subordinates than their counterparts. This is something of an exception to a rule in that crosstrainees were indicated to have higher expected values than non-crosstrainees in only 5 percent of the possible point-of-service/specialty situations.

Summary

The major finding with regard to the relationships between length of service and the criteria is that these relationships are consistently significant, and when they are significant, they are predominately positive. For three criteria (grade, reenlistment intent, and number of subordinates), the relationships were significant in all specialties. Only for the job interest criterion were more than half of the relationships (53%) non-significant. Of the significant relationships for each criterion, at least 80 percent were positive. For the grade level, reenlistment intent, felt utilization of talents and training, and number of subordinates criteria, this percentage is 95 or higher. One overall indication of these findings is that the standings of Air Force enlisted personnel on the criteria of this study – except for job interest – can generally be expected to increase with time in service.

With regard to relationships with crosstraining status, the criteria fall into two convenient categories. One category consists of the three attitude variables (reenlistment intent, job interest, and felt utilization of talents and training). For these variables, the differences between crosstrained and non-crosstrained groups were significant only 15 percent of the time. In situations where these differences occurred, one group had the higher expected criterion values about as often as the other (crosstrainees were higher 53% of the time vs. 47% for non-crosstrainees). For this category of criteria then, there is no clear-cut implication with regard to crosstraining status.

The other category of criteria includes grade level and the job characteristic variables, number of tasks performed, job difficulty, and number of subordinates. Significant differences were found between crosstrained and non-crosstrained groups in this category 22 percent of the time. In these instances, non-crosstrainees had the higher expected criterion value 90 percent of the time. The implication here is that, in a number of Air Force specialties, crosstrainees are at a slight disadvantage with regard to promotions, and their jobs are somewhat less complex, difficult, and demanding than those of their counterparts.

Conclusions

When interpreting these results, it is important to keep in mind that the purpose of this study was simply to detect gross differences between crosstrainees and non-crosstrainees in certain specialties with regard to specific criteria. The question addressed was whether the available

occupational data indicated that an in-depth study of crosstraining system operations might be appropriate. Questions as to whether any detected differences warrant corrective action and what corrective action would be most effective were beyond the scope of the study. Other questions which remain unanswered include whether other specialties also have important crosstraining status differences on these criteria and whether differences exist with regard to other measures of efficiency, productivity, job attitudes, job characteristics, etc.

Another important consideration when interpreting these results is that the study was designed to detect only *gross* differences. The relatively large sample sizes and the exclusion of subjects with more than 20 years of service had the effect of making the tests more sensitive to differences. However, those effects were more than negated by (a) the use of the .01 significance level, (b) the elimination of personnel with less than 4 years of service from the samples, and (c) the self-elimination from the samples by crosstrainees and non-crosstrainees who had chosen not to reenlist. Another factor which contributed to the insensitivity of the tests was the non-differentiation of the crosstrainee samples. More differences would probably have been detected if considerations had been given to such things as the type of specialty crosstrained from, time since crosstraining, and the extent the crosstraining action was resented or desired by the crosstrainee.

Despite the conservative nature of these analyses, significant and appreciable differences were found in several speicalties with regard to the grade level and assignment characteristic criteria. Considered along with the potential costs of these differences to the Air Force and its individual members (see Introduction section), these findings do indeed indicate that a thorough investigation of the operations and effects of the crosstraining system are appropriate. The Air Force Human Resources Laboratory has already initiated several research efforts to answer some of the questions raised by these findings.

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APPENDIX A: SCHEME FOR DETERMINING APPROPRIATE MODEL

Figure A1 is a representation of the scheme used for determining which of the 14 models considered is the most appropriate for describing the interrelationships of the criterion, crosstraining status, and length of service variables. Essentially the scheme is designed to find the simplest model with the highest predictive efficiency. In this figure, triangles enclose *F*-test designations and values in squares designate regression models. If an *F*-test is significant, the block below and to the right of it indicates the appropriate model or the next *F*-test in sequence. Otherwise the block below and to the left is the indicator. Table A1 contains statements of the hypotheses tested with the associated *F*-ratios and regression models.

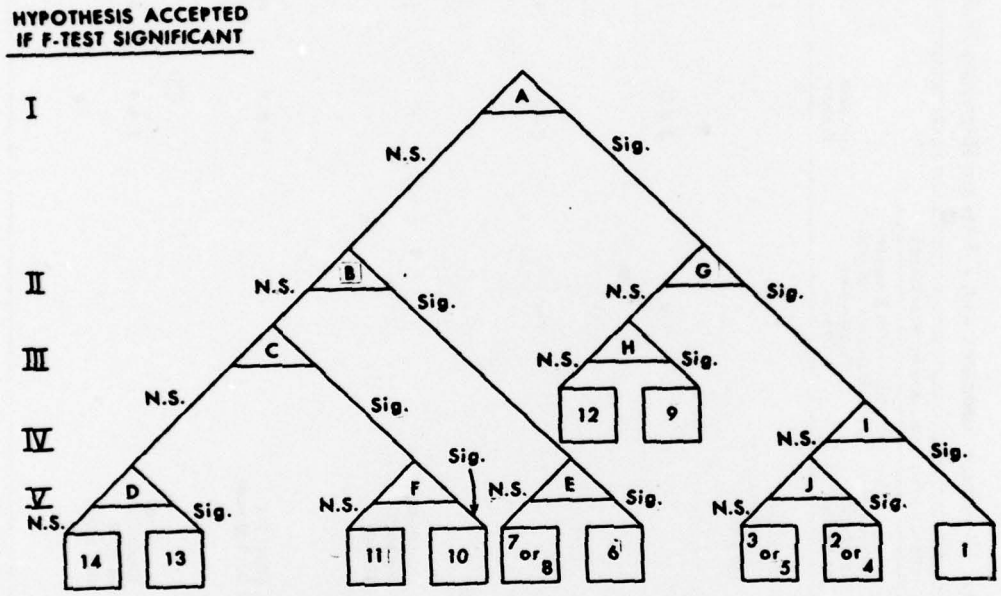

Figure A1. F-test contingency table.

F-Test A (for RSQ1-RSQ6) of Hypothesis I

The first *F*-test compares the predictive efficiency of model 1 (RSQ1) with that of model 6 (RSQ6). The hypothesis here is that, for at least one of the crosstraining status groups, non-constant changes occur in expected criterion values with increasing length of service (i.e., that a curvilinear relationship exists between the criterion and length of service for either crosstrainees or non-crosstrainees or both). The null hypothesis is that the data describing the relationship of these variables – for both crosstrainees and non-crosstrainees – are described as accurately by a straight regression line as by a curved regression line.

If this test is significant (the difference between RSQ6 and RSQ1 is greater than would be expected by chance), then model 6 can be eliminated from further consideration in the search for the appropriate model. Also, any models which are restrictions of model 6 (7, 8, 10, 11, 13, and

Table A1. **Hypothesis Associated with F-Tests and Regression Models**

Hypothesis Number	Statement of Hypothesis	Relationship Indicated by Acceptance		Involved F-tests	Regression Models with Provisions for Acceptance of Hypothesis	Regression Models with Provisions for Rejection of Hypothesis
		Criterion to Length of Service	Difference Between Crosstrainee and Non-Crosstrainee Groups			
I.	A *non-constant rate of change* occurs in expected criterion values with increasing length of service *for either* crosstraining status *group*.	curvilinear for at least one group		A	1, 2, 3, 4, 5, 9 & 12	6, 7, 8, 10, 11, 13 & 14
II.	With increasing length of service a *non-constant difference* occurs between expected criterion values for crosstrainees and non-crosstrainees.		Yes	B & G	1, 2, 3, 4, 5, 6, 7 & 8	9, 10, 11, 12, 13 & 14
III.	With increasing length of service a *constant difference* occurs between expected criterion values for crosstrainees and non-crosstrainees (assumes hypothesis II rejected).		Yes	C & H	9, 10 & 11	12, 13 & 14
IV.	A *non-constant rate of change* occurs in expected criterion values with increasing length of service *for the other* crosstraining status *groups* (assumes hypothesis I accepted).	curvilinear for both groups		I	1	2, 3, 4 & 5
V.a.	A *constant rate of change* occurs in expected criterion values with increasing length of service *for both* crosstraining status *groups* (assumes hypothesis II rejected).	linear for both groups		D & F	10 & 13	11 & 14
V.b.	A *constant rate of change* occurs in expected criterion values with increasing length of service *for one* crosstraining status *group* (assumes hypothesis II accepted).	linear for at least one group		E & J	2, 4 & 6	3, 5, 7 & 8

14) can be eliminated. Since RSQ values for these models could not be larger than RSQ6, the difference between any of these and RSQ1 would have to be larger than a difference already established as significant. In this situation, the hypothesis is accepted, and the procedure continues with *F*-test G.

If *F*-test A is not significant, then neither RSQ1 nor any of the RSQ values for the models which are restrictions of model 1 (2, 3, 4, 5, 9, and 12) are significantly greater than RSQ6. The appropriate actions in this case are (a) to accept the null hypothesis (that any change in expected criterion values with increasing length of service occurs at a constant rate, or that no curvilinear relationship exists between these variables for either crosstraining status group) and (b) to proceed with *F*-test B and subsequent test(s) to ascertain that a restriction of model 6 does not describe the relationship of variables as accurately as that full model.

F-Test B (for RSQ6-RSQ10) of Hypothesis II for Models with Straight Lines

The formal hypothesis being tested here is that a difference exists between the expected criterion values of crosstrainees and non-crosstrainees and this difference changes with length of service. Another way of stating this hypothesis is that the slopes of the regression lines appropriate for describing the relationships between the criterion and length of service for each crosstraining status group are different. In other words these regression lines are independent or free to converge, diverge, or both (if they intersect within the range of interest).

If this test is significant, the hypothesis is accepted, model 10 and its restrictions are eliminated and the procedure continues with *F*-test E. Otherwise the null hypothesis (that the difference between the groups is a constant and possibly zero value, or that the regression lines for the groups have a common slope and thus are either parallel or coinciding), is accepted and *F*-test C is considered.

F-Test C (for RSQ10-RSQ13) of Hypothesis III for Models with Straight Lines

After it has been established that the difference between the regression lines at any point of service is a constant or zero value, it remains to be determined whether or not that difference is zero. The hypothesis tested with *F*-test C is that this value is *not* zero or that the regression lines are parallel and not colinear. If this test is significant, the hypothesis is accepted, models 13 and 14 are eliminated, and the procedure continues with *F*-test F. If it is not significant, the null hypothesis – that no difference exists between crosstraining status groups – is accepted and models 10 and 11 are eliminated. In this case, the result of *F*-test D is used to determine the appropriate model.

F-Test D (for RSQ13-Zero) of Hypothesis V for Models with One Line

After rejecting the hypotheses for *F*-tests A, B, and C, the remaining hypothesis is that the criterion is linearly related to length of service, or with increasing length of service the expected criterion scores change at a constant, non-zero rate, or the regression line best fitting the data on the criterion to length-of-service relationship is sloped. If the test is significant, the hypothesis is accepted, and model 13 is accepted as the appropriate model. If not, the null hypotheses of *no* constant rate of change in expected criterion values is accepted. Since the hypothesis of any non-constant rate of change has also been rejected (in *F*-test A), it can be inferred that there are *no* differences in the rate of change in expected criterion values and thus that there is no relationship (either linear or curvilinear) between length of service and the criterion for either crosstraining status group. In this case model 14 (represented graphically as an unsloped line) is

accepted as appropriate because it is the only model among the 14 considered which has properties in accord with the null hypotheses accepted with *F*-tests A, B, C and D.

F-Test E (for RSQ6-RSQ7 or RSQ6-RSQ8) of Hypothesis V for Models with Independent Lines

The only models which have properties in accord with the null hypothesis accepted in *F*-test A and the hypothesis accepted in *F*-test B are 6, 7, and 8. One of these models, either 7 or 8, can be eliminated from consideration as being the appropriate model on the basis of a direct comparison of RSQ values. It is inconceivable that the model with the lower RSQ value could be the appropriate model because accepting it would mean rejecting another which is just as parsimonious and has a higher predictive efficiency. Thus, the restricted model for this test is 7 if RSQ7 is greater than RSQ8, or 8 if RSQ8 is greater than RSQ7. It is possible that RSQ7 could be exactly equal to RSQ8. In this case the common difference between the potential restricted models and the full model would logically be significant, and model 6 would be indicated appropriate. Otherwise, the indication is that each of the two groups requires sloped regression lines. This is *also* an indication that model 6 is appropriate.

After accepting the hypothesis of non-constant differences (in *F*-test B), it can be inferred that separate regression lines with different slopes are appropriate for the two crosstraining status groups. A further inference is that since the slopes of these lines are different, only one could possibly have a zero slope. In other words, for only one of the groups might there not be a linear relationship between the criterion and length of service. The hypothesis for this *F*-test is the same as that of *F*-test D except that it applies to the criterion to length-of-service relationship for only one of the groups, either crosstrainees (if model 8 is the restricted model) or non-crosstrainees (if model 7 is involved). If this test is significant, then the hypothesis is accepted, a linear relationship between criterion and length of service can be inferred for both crosstraining status groups, and model 6 is accepted as appropriate. If the test is not significant, the inference is that there is no criterion to length-of-service relationship for one of the crosstraining status groups and that the restricted model of the test (either 7 or 8) is most appropriate.

F-Test F (for RSQ10-RSQ11) of Hypothesis V for Models with Parallel Lines

After accepting the hypothesis of *F*-test C, the testing sequence picks up here. The hypothesis tested at this point is the same as for *F*-test D. The only difference in the situation is that models with separate regression lines for each crosstraining status group are involved. If the test is significant, then the common sloped regression lines of model 10 most appropriately describe the criterion to length-of-service data, and both a linear relationship and crosstraining status group differences in expected values are indicated. If *F*-test F is not significant, model 11 is most appropriate, indicating a constant difference between expected criterion values for crosstrainees and non-crosstrainees but no relationship between the criterion and length of service, or no change in expected criterion values with increasing length of service.

F-Test G (for RSQ1-RSQ9) of Hypothesis II for Curvilinear Models

After accepting the hypothesis that at least one regression curve is appropriate for describing the data (from *F*-test A), the remaining task is to identify which crosstraining status group requires the curve and determine whether the other group requires the same curve, a parallel curve, a different curve, a sloped line or an unsloped line. This identification process begins with *F*-test G. The hypothesis here is the same as for *F*-test B, that the difference between the expected criterion values for crosstrainees and non-crosstrainees is a non-constant value which varies

with length of service. In this situation, however, the difference involved is between curves rather than straight lines. If the test is significant, the hypothesis is accepted, models 9 and 12 are eliminated from consideration and the procedure continues with *F*-test I. If the test is not significant, the null hypothesis (that the difference in expected criterion values is the same regardless of length of service) is accepted and *F*-test H is considered to determine whether or not this constant difference is zero.

F-Test H (for RSQ9-RSQ12) of Hypothesis III for Curvilinear Models

This test is analogous to *F*-test C. Again, the only difference is that regression curves rather than regression lines are being tested for differences. If the test is significant, the hypothesis of crosstraining status group differences in expected criterion values is accepted and model 9 (which provides separate but parallel regression curves to describe the criterion to length-of-service relationship for the two groups) is accepted as most appropriate.

If *F*-test H is not significant, then the null hypothesis (that there is no difference between the regression curves for each crosstraining status group) is accepted, and model 12 is accepted as appropriate. Notice that subsequent tests for a constant rate of change in expected criterion values (analogous to *F*-tests D and F subsequent to C) are not required because the existence of a non-constant rate of change has already been established (in *F*-test A).

F-Test I (for RSQ1-RSQ2 or RSQ1-RSQ4) of Hypothesis IV

If the hypotheses in *F*-tests A and G are accepted, this *F*-test is next. Either model 2 or model 4 is eliminated from the model-seeking procedure by a direct comparison of their RSQ values. If model 2 has the higher predictive efficiency, it is the appropriate restricted model for this test. If RSQ4 is greater than RSQ2, then model 4 is the restricted model. The rationale for this elimination is the same as involved in the elimination of model 7 or 8 (see discussion of *F*-test E).

The hypothesis that a non-constant rate of change in expected criterion values occurs with increasing length of service for *one* of the crosstraining status groups was accepted in *F*-test A. The hypothesis here is that the same condition exists for the *other* group. If the test is significant, the hypothesis is accepted and the inference made that the model providing independent curved regression lines for both crosstraining status groups (model 1) is appropriate. If the test is non-significant, then the null hypothesis (that the rate of change is expected criterion values with increasing length of service for the one group is a constant value) is accepted. It then remains to be determined (with *F*-test J) whether or not this constant difference is zero.

F-Test J (for RSQ2-RSQ3 or RSQ4-RSQ5) of Hypothesis V for Curvilinear Models

The full model for this test is the same one used as the restricted model of *F*-test I. The hypothesis tested here is the same as for *F*-tests D, E, and F. It is: expected criterion values (for one crosstraining status group in this case) change at a constant rate with increasing length of service, or that a linear relationship exists between the criterion and length of service. If the test is significant, the hypothesis is accepted and the full model (either 2 or 4) is accepted as being appropriate. Otherwise the null hypothesis is accepted and the restricted model (either 3 or 5) which provides for no relationship (neither linear not curvilinear) between criterion and length of service for one group, and for a curvilinear relationship for the other group is accepted as appropriate.

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